Nova-NOTE-SCINT-49

Updated Results from Creep Tests On Commercial PVC

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Abstract

We present about one year's worth of creep data on PVC cut from a commercial car wash door extrusion made by Extrutech. Creep can be well represented so far by a logarithmic time dependence. The rate of creep is consistent with being exponentially dependent on the stress. Stresses range from 633 psi to 2908 psi. An earlier sample stressed at 5279 psi failed within minutes.

Introduction

The Fermilab Off-axis experiment proposal "NOVA" uses scintillating oil-filled PVC extrusions as the radiator to detect charged particle tracks.
The great depth of the liquid column creates a substantial hydrostatic pressure, about 19 psi. The PVC extrusion contributes significant cost, and one tries to keep the amount of material and the wall thickness as small as can be safely achieved.
Ultimate strength of PVC (in the 6000 psi range) can be measured quickly. Long term effects can include stress creep and interaction with the liquid. Those take longer to determine.

I have stressed 6 samples taken from a commercial extrusion similar to what would be used in NOVA. The samples (see Fig. 1 for dimensions) were cut at right angles to the extruder direction in order to apply the stress in the same direction that the highest stresses will occur in the experiment. The stresses were:

Sample #	**1**	**2**	**3**	**4A**	**4B**	**5**	**6**
Stress [psi]	633	1132	2632	5279	2602	1964	2908

One sample (4A) sample was stressed to 5279 psi and failed within minutes.
It was replaced with sample 4B for most of the run, and is labeled #4 in the following graphs.

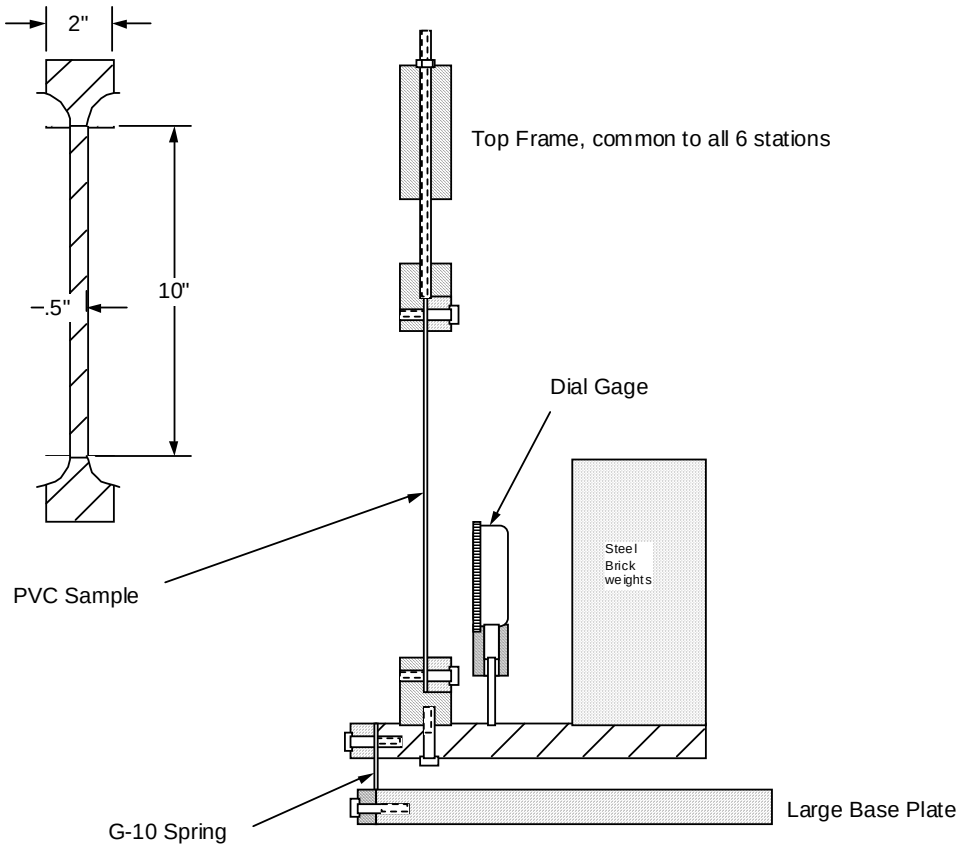


Fig. 1 The creep tester. The figure shows on of 6 stations.

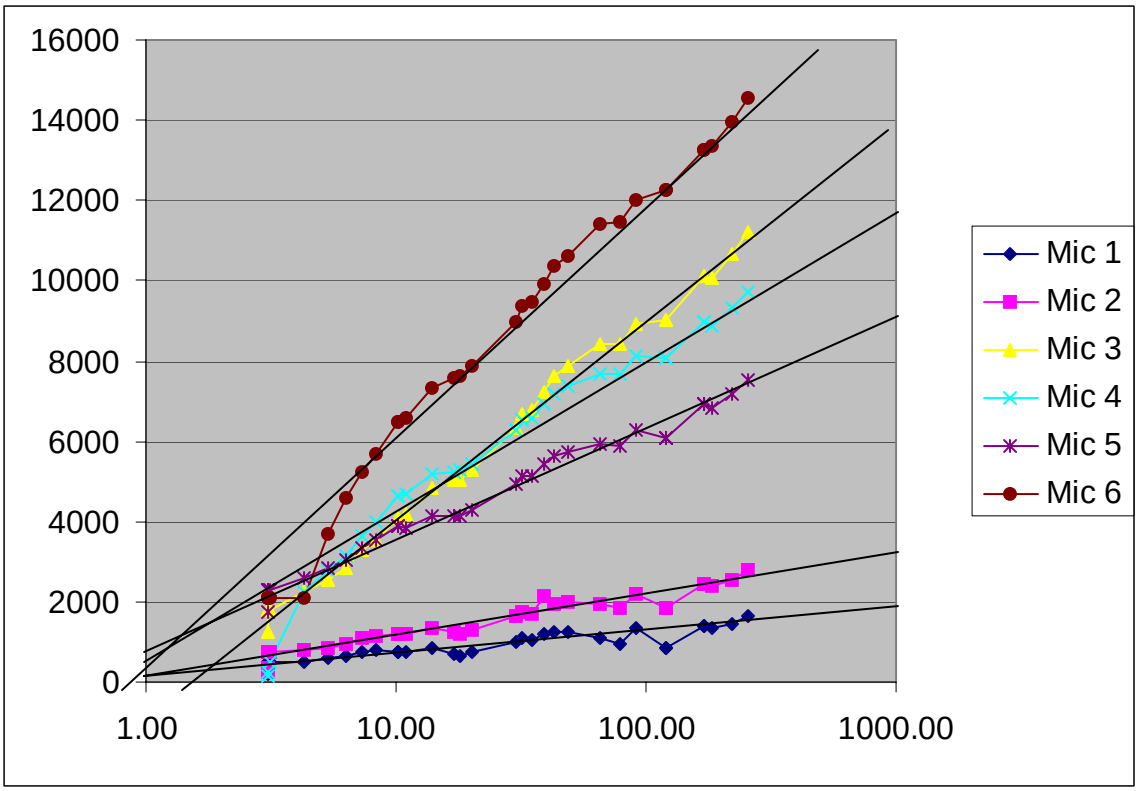
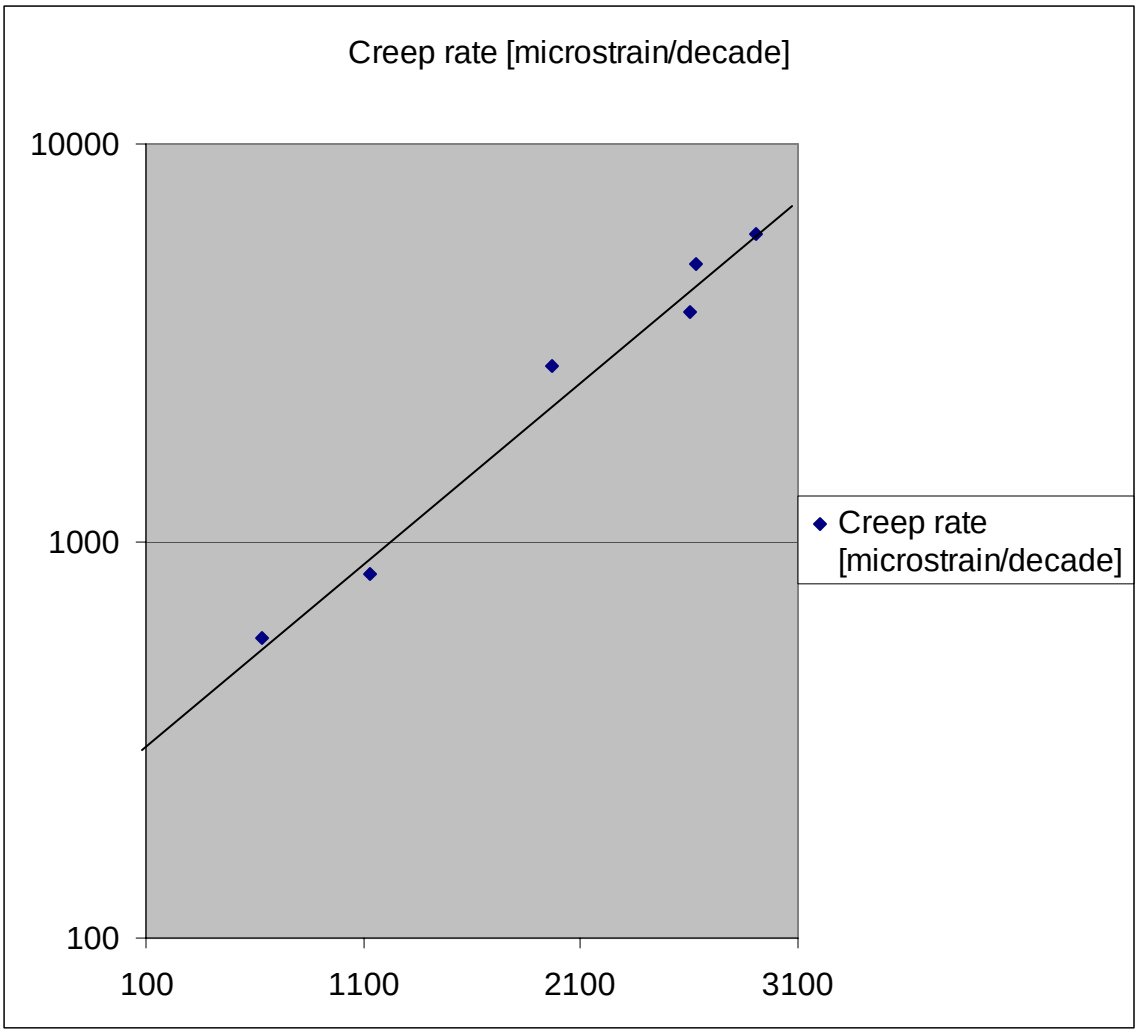


Fig. 2: Time dependence of sample elongation under stress.
Data are shown in units of "Microstrain" (ppm elongation) versus time in days.

All graphs start out flat. This is an artifact of the semi-log plot.
Clearly the samples did not start out at negative infinity at time zero.



Fig, 3: The creep rates in Fig. 2 were approximated as simple exponentials (by hand; not shown in the figure) for the data beyond day 3 or so.
The rates are approximately an exponential function of the stress.
A power law fit works less well.

We will continue to observe the samples, and later replace them with the more "final" material as the extrusion development progresses.
Meanwhile it is hoped that the parameterization of the initial creep data can be used in FEA analyses of the detector, in view of understanding wall thickness and other requirements.